

Public perception of university students in Honduras about Biotechnology – Synthetic Biology and GMOs

Lucas Rocha Melogno

Ana Morales

Sergio Urioste

Advisor:

Arie Sanders. M. Sc

Contents

Introduction.....	3
Theoretical Frame	4
Methodology	6
Results	7
Conclusions	11
Bibliography	12

Introduction

Synthetic biology is a research field that combines the investigative nature of biology with the constructive nature of engineering; the result is the creation and perfection of genetic devices (Purnick & Weiss, 2009). Synthetic biology has a wide range of applications, such as bioremediation, sustainable energy production and biomedical therapies. But as this field is not as old as others, many people around the world are just getting idea about what synthetic biology is. According to the context and environment of the people, the public perception that they get will be positive or negative.

The principal purpose of this project was to know the level of approval and knowledge about biotechnology and GMO's within the population that has access to higher education in Tegucigalpa, Honduras; assuming that this group will be the most economically active in the next 30 years and being able to adapt synthetic biology into their different professional activities. The importance of this investigation is that the information that we got could be used as a tool in the taking of decisions to improve the knowledge of people about synthetic biology and especially as a tool in risk analysis.

The population of study was university students from Zamorano and other universities, all of them with an average age of 21 years. The first group, Zamorano students, belong to different areas such as agroindustry, environmental and development engineering, agribusiness and agronomy science, whereas students from the second group belong to areas as economy, biology, medicine, pharmacy, microbiology, ecology and others.

The specific objectives are i) determine the differences of public perception about synthetic biology between students of Zamorano and students from other universities in Tegucigalpa, and ii) establish the level of acceptation of students from Zamorano and others universities about the use of synthetic biology.

Theoretical Frame

As Dr. Hallman mentions in his research ***Public Perceptions of Agricultural Biotechnology: A Survey of New Jersey Residents***, biotechnology has high expectations in the economic and environmental field as it demonstrates to be a science that for example, has helped developing new varieties of plants and animals that have better characteristics than their predecessors resulting in the improvement of agricultural productivity. (Hallman & Metcalfe, 1994). 20 years have passed since his research and interest in Biotechnology has not changed but even grown since then. What's interesting is that in his research, people that are involved in food production and medical professionals had no difference about their knowledge of genetic engineering (Hallman & Metcalfe, 1994). This is something that seems to be different 20 years later in Honduras according to our research where the group of the population that is involved in food production, appears to be the group that has more knowledge about genetic engineering and biotechnology.

In another research from the University of North Carolina in 2004, Thomas Hoban demonstrated that biotechnology will only be used in agriculture if the market considers it safe and beneficial. Thomas Hoban also mentions that based on evidence from several public perception studies, the attitude towards biotechnology is different between and within countries and that it has a dynamic change over time. (Hoban, 2004). Finally what's very interesting in his research is that there are marked differences between public acceptance of different biotechnological products; according to Environics International, 85% of 35000 respondents from 35 countries support the use of biotechnology for the development of human medicines while almost 75% of them rejected the idea of genetic modification of animals to increase productivity (Environics International, 2000).

Eleonore Pauwels, in her article "***Public understanding of Synthetic biology***", also provides really interesting tendencies found in her 4 years of research upon the topic. She mentions that the US population has contradictory ideas about this science; most of them demonstrated enthusiasm about synthetic biology applications then they are related to societal, medical or sustainable issues. On the other hand, engineering biology was found as a matter of preoccupation where people agreed that this type of research should be done considering all the potential risks and long-term implications. "When it comes to oversight, their priorities are to promote transparency and accountability and to ensure a form of tailored governance in which diverse knowledge sources help address the uncertainty surrounding new technologies" (Pauwels, 2013). This can show the importance of public perception when it comes to develop new applications of Synthetic Biology in order to be accepted by the population of a specific country

and the need for legitimate information and the easy access to it with a correct regulation either by their Government, international organizations or Non-Governmental Organizations (NGO's).

There is big gap between United States of America (USA) and Europe Union (EU) in the application of synthetic biology. Till 2008 in EU, 14 countries, 35 universities and 10 companies were conducting synthetic biology research, with a total investment of around 30 million dollars; whereas in USA, more than 30 states, 100 universities and 50 companies were applying this science, with a higher investment of around 1 billion dollar (Pauwels and Ifrim, 2008). Although in the EU there has been less investment in synthetic biology research, the amount of articles about this topic were higher in this zone than in USA. Most of the articles (59%), mentioned that this science could bring both, beneficent and risk; 29% only benefits and a 6% only risks. Later in 2008, a research done in Maryland (EU) about public perception showed that, although a 70% of the participant that did not have an exactly concept of synthetic biology, they related it with both, benefits and risk (Pauwels, 2009).

Public perception between developing countries doesn't change too much, because of the level income and similar political situations. A study compares the perception that stakeholders from Philippines and Mexico have about agricultural biotechnology. The study concludes that both countries firmly approve the use of biotechnology and agree with the benefits that it has for food production, however, they have concerns about the hazards in biodiversity and human health, because they don't trust that laws that regulate the technology in their countries is being implemented correctly (Aerni, 2002).

This pattern of concern about the correct implementation of the policies and the lack of knowledge of the risks that modified organisms have is supported by studies conducted in Kenya, China and Malaysia. However the highly acceptance of the benefits that the modified organisms have for food production, make that people tend to accept the technology (Gatharaa, Ngugi, Kilambya, & Gichuki 2008, Amin, Azlan, Ahmad, & Ibrahim 2011, Ho, Zhao, & Xue 2009).

Methodology

In order to do an analysis of the public perception about Synthetic Biology and GMO's we decided to modify an already done survey by Dr. William K. Hallman from the Department of Human Ecology at the State University of New Jersey "Rutgers". Dr. Hallman's survey title is ***"Public Perceptions of Agricultural Biotechnology: A Survey of New Jersey Residents"***. After having his permission, we adapted the survey to the Honduran context and modified certain questions.

The population aimed by the survey were several university students from different majors; economy, business, agronomy, agroindustry, biology, pure sciences, among others. Their age range went from 16 years old to 26 and older.

The survey was launched online at SurveyMonkey.com and was then distributed by email and social network pages to random selected students studying at Zamorano University, Catholic Honduran University (UNICAH), Central American Technological University (UNITEC), National Autonomous University of Honduras (UNAH) and "another" option was also available for people studying in another university that may have received the survey.

The survey was based on the Likert scale, giving values from 1 to 5 to the answers of the questions. The possible answers were: 1= strongly disagree; 2 = disagree; 3 = Undecided; 4 = Agree; 5 = strongly agree. Some of the questions about awareness of a certain topic only needed two possible values; being 1 = yes and 0 = otherwise.

The survey had 38 questions and they were grouped by different topics, these were:

- Basic knowledge about food production
- Knowledge and level of approval of hybrid plants and animals
- Level of approval of GMO's and general knowledge about biotechnology
- GMO considerations
- Synthetic Biology considerations and awareness

After one month of gathering responses, 357 surveys were answered, having to filter them to 301, as 56 of them were not filled out correctly. As the size of the analyzed population was not big enough to differentiate each university's group, the team decided to analyze only two groups; "Zamorano students" and "other universities".

Results were finally analyzed with the predictive analytics software SPSS in order to find significant differences between both groups and correlations among different questions looking for the causes of their level of approval about biotechnology practices and GMO's. These results were used for the development of the risk analysis tool and the planification of the educational practices with elementary school children that the team conducted.

Results

Table 1: Basic knowledge about food production

Aspect	Others	Zamorano	Significance <i>p</i>
Food production knowledge	3.36	3.79	<0.01
in stores and supermarkets	.235	.435	<0.01
Use of chemicals in food production	3.66	3.56	No difference
Care about the consumption of organic and free pesticides food	4.26	3.74	<0.01
Awareness of crossbreeding methods for food production	.629	.870	<0.01

It is important to know people's understanding about biotechnology techniques to produce food and the production itself. Through the survey and its analysis, found that there is a significant difference between the two population of interest, Zamorano and the other universities in Honduras. To understand the basic knowledge about the purposed topics of study, this section had five different questions, where there was a 99% statistical difference between Zamorano and other universities in the five stated questions. The knowledge about food production is higher in Zamorano, as well, the knowledge of hybrid methods to create plants and animals improved varieties. This fact can be explained through the area of study in Zamorano agricultural sciences.

When the populations were asked about their knowledge of use of pesticides in the food that they consumed, Zamorano's population were less exigent with the use of pesticides and organic food production, however, there is a higher frequency of people who have seen organic labeled food in Zamorano's population.

Table 2: Knowledge and level of approval of hybrid plants and animals

Aspect	Others	Zamorano	Significance <i>p</i>
Consumption of genetically modified food	.524	.687	<0.01
Approval of genetically modified food production	3.22	3.98	<0.01
¿Production of hybrid plants is morally correct?	3.12	3.70	<0.01
Approval of genetically modified animals	2.55	3.32	<0.01
Genetically modified animals production is morally correct	2.45	3.31	<0.01

To be more specific, the survey contained five questions to understand the knowledge about hybrid plants and animals. It has found that there is a 99% significance difference between each population in the five stated questions. It is evident that Zamorano's students tend to answer that they know more about the techniques. For example, Zamorano population agree that they have eaten before food that has been grown using biotechnology techniques to create hybrid varieties, as well in the questions about the approval of the use of crossbreeding to grow plants for food and if it is morally correct to do that. This pattern repeats when they answer about the use of crossbreeding for animals.

Table 3: Level of approval of GMO's and general knowledge about biotechnology

Aspect	Others	Zamorano	Significance <i>p</i>
Science and Technology understanding	3.89	3.99	No difference
Splicing of genes in plants and animals	2.48	3.19	<0.01
Genetically modified plants level of approval	3.05	3.70	<0.01
Is plant genetically modification morally correct?	2.95	3.55	<0.01
Genetically modified animals level of approval	2.37	3.08	<0.01
Is animal genetically modification morally correct?	2.37	3.04	<0.01
GMO's could be dangerous for the environment if they could reproduce by themselves	3.60	3.01	<0.01

In the table above we were able to see that both populations don't show a significant difference between their basic knowledge about science and technology since both of them agree that they have good bases. On the other hand, Zamorano students replied that their basic knowledge about biotechnology was very good meaning that they had received classes about the topic or read scientific journal articles. Students from other universities replied that they had received little information about the topic meaning that most of it was from conversations, TV or newspaper or magazine articles.

In terms of their level of approval about genetically modified plants, Zamorano students showed more acceptance than other universities but this second group demonstrated that they didn't agree nor disagree about the topic. What's interesting is that students from other universities mostly think that genetically modifying either a plant or animal is morally incorrect while Zamorano students only think that genetically modify plants is, but don't think that it is or not morally incorrect to genetically modify animals.

Finally we were able to see that the students from other universities mostly think that if a genetically modified organism could reproduce by itself it could mean a danger for the environment while Zamorano students neither agree nor disagree with this possibility.

Table 4: GMO's considerations

Aspect	Others	Zamorano	Significance <i>p</i>
Genetically modified plants are better than plants which requires pesticides	3.49	3.76	<0.05
Genetically modified plants should be considered as "organics"	2.71	2.67	No difference
Genetically modified plants should not be sold in "natural product shops"	3.33	2.89	<0.01
Genetically modified organisms are a potential risk for human health	3.52	2.75	<0.01
Genetically modified organisms requires a strict regulation	4.34	4.12	<0.05
Genetically modified organisms risk have been exaggerated	3.34	3.46	<0.1

Here we can see that both of the student's groups tend to agree that genetically modified plants are better than the not modified ones but Zamorano students tend to have a stronger level of approval. What's interesting is that both of the groups think that food produced by genetically modified plants shouldn't be labeled as

“organic” food even if this plants would fulfill all the “organic” food production requirements. Another interesting result is that Zamorano students tend to think that genetically modified food shouldn’t be sold at “natural products” stores while students from other universities neither agree nor disagree with the idea.

Other university students also tend to agree that genetically modified organisms represent a potential danger for human health and the environment while Zamorano students disagree with this notion. Furthermore, Zamorano students also tend to think that unjustified fears and risks have been exaggerated in the general population while students from other universities don’t show this tendency in their responses.

Finally, it is easy to see that even though both groups of students have different thoughts and considerations about GMO’s, both agree that biotechnology and the genetically modifying practices have to be strictly regulated by national governments and international organizations. This is a positive feedback in order to develop our project’s risk analysis assessment, as both populations are aware of its importance.

Table 5: Synthetic Biology considerations and awareness

Aspect	Others	Zamorano	Significance <i>p</i>
Genetic modification of organisms could be a source of work and income for population	3.21	3.31	No difference
People should not know how to genetically modify an organism	1.98	1.74	<0.05
Only moderate regulations would be needed to regulate genetic modification of organisms	2.31	2.34	No difference
Genetic modification of organisms could improve my quality of life	2.89	3.34	<0.01
Research in genetic modification or organisms should increase worldwide	3.58	3.87	<0.05
Knowledge about Synthetic biology and its potential uses	2.42	2.92	<0.01

As a part of our research we wanted to know the differences between the perception of synthetic biology and level of approval of students of Zamorano University and students from other Honduran universities.

To start with, the results of the survey did not show significant statistical difference between students of Zamorano and from other universities about the use of synthetic biology to solve specific problems, both groups agree on the use of this

technology. Furthermore, both groups think that the genetic modification of organisms could be a future source of jobs and income for the general population and that the Honduran scientists involved in such research have a good knowledge of synthetic biology and its repercussions, so that only moderate regulations on genetic engineering research would probably be necessary.

On the other hand, the survey showed that there is a significant statistical difference, at the 90% of confidence level, between students of Zamorano and students from other universities regarding increasing or emphasizing genetic engineering research at the university level. The former group agrees in increasing research on this topic and that the general population should be educated about the topic of genetic engineering, while the latter group has no opinion either way. Finally with a statistical significant difference of 95% confidence, the survey has showed differences between the two groups about their knowledge of synthetic biology and its potential to improve quality of life. Zamorano students have received enough information about synthetic biology (from newspaper articles, magazines, radio and TV programs) and, as a result, are of the opinion that it will improve the quality of life; whereas students from other universities have received only little information concerning synthetic biology and as a result have no opinion about its potential to increase the population quality of life.

Conclusions

Due to the influence and education received related to agricultural areas, Zamorano students tend to have a deeper knowledge about the use of biotechnology to create hybrid plants and animals for food production. They are also less demanding about restrictions to the use of pesticides in food production and the consumption of organic food.

We concluded that although there is a significant statistical difference between groups, students from Zamorano and other universities in Honduras are aware that biotechnology research needs efficient regulation policies.

On the other hand, their level of knowledge about Synthetic Biology and GMO's is clearly deficient: thus, the need and importance of providing the general population with the required impartial and legitimate information that would allow them to make up their own opinions on these subjects.

Bibliography

- Aerni, P. (2002). Stakeholder Attitudes Toward the Risks and Benefits of Agricultural Biotechnology in Developing Countries: A Comparison Between Mexico and the Philippines. *Risk Analysis: An International Journal*, 22(6), 1123-1137.
- Amin, L., Azlan, N., Ahmad, J., & Ibrahim, R. (2011). Public Perception of the Ethical Aspects of Golden Rice in Malaysia. *International Journal of Science in Society*, 2(4), 15-34.
- Environics International. (2000). *International Environmental Monitor 2000*. Toronto: Environics International.
- Gatharaa, V., Ngugi, J., Kilambya, D., & Gichuki, T. (2008). Consumers' Perceptions of Biotechnology in Kenya. *Journal of Agricultural & Food Information*, 9(4), 354-361.
- Hallman, W., & Metcalfe, J. (1994). Public Perceptions of Agricultural Biotechnology: a Survey of New Jersey Residents. *Food Policy Institute*, 1.
- Ho, P., Zhao, J., & Xue, D. (2009). Access and control of agro-biotechnology: Bt cotton, ecological change and risk in China. *Journal of Peasant Studies*, 36(2), 345-364.
- Hoban, T. (2004). Public attitudes towards agricultural biotechnology. *Food and Agriculture Organization*.
- Pauwels, E. (2013). Public understanding of Synthetic Biology. *BioScience*.
- Pauwels E. and I. Ifrim. (2008), Trends in American and European press coverage of synthetic biology: Tracking the last five years of coverage. Synthetic Biology Project 2008.
- Pauwels, E. 2009. Public perception and Media: The case of synthetic Biology. Woodrow Wilson International Center for Scholars. Available on: <http://ec.europa.eu/bepa/european-group-ethics/docs/archives/ege-ep.pdf>
- Purnick, P., & Weiss, R. (2009). The second wave of synthetic biology: from modules to systems. *Nature Reviews Molecular Cell Biology*, 10, 410-422. Obtenido de <http://www.nature.com/nrm/journal/v10/n6/abs/nrm2698.html>